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Sign-Tracking and Drug Addiction

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DOI: <http://dx.doi.org/10.3998/mpub.10215070>



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Chapter 8: Telling Stories about Sign-Tracking Boosts Awareness of Loss of Self-Control Related to Drug Use

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Abstract

In the United States, there are ongoing epidemics of drug addiction and drug overdose deaths, accompanied by an alarming increase in the number of young victims. Unfortunately, the epidemics reveal that primary prevention programs developed to stop drug addiction before it starts have been largely ineffective. A new primary prevention tool is needed. This chapter describes two experiments that employ storytelling to deliver scientific lessons about the loss of self-control due to the Pavlovian conditioning of sign-tracking. In experiment 1, the experimental group read the scientific short story, *The Tail of the Raccoon: Secrets of Addiction (Illustrated)*, while the control group read *Where the Buffaloes Begin*. Survey 1 was administered before and after each group read their story. Analysis of Survey 1 responses revealed no evidence of group differences in awareness of self-control and no evidence of an increase in awareness of self-control as a result of reading the story. In experiment 2, the experimental group read the scientific short story, *The Tail of the Raccoon, Part II: Touching the Invisible (Illustrated)*, while the control group read *The Call of the Wild*. Survey 2 was administered to each group before and after reading their story. Analysis of Survey 2 responses revealed that the experimental group, relative to the control group, provided significantly higher post-treatment ratings of self-control awareness, as well as significantly elevated ratings of their understanding of how loss of self-control can lead to drug addiction. These group differences were not observed for survey questions that did not pertain to self-control. The results provide evidence that reading *The Tail of the Raccoon: Secrets of Addiction (Illustrated)* and then reading *The Tail of the Raccoon, Part II: Touching the Invisible (Illustrated)* boosted awareness of the loss of self-control and, in addition, improved understanding of how the loss of self-control contributes to drug addiction.

Keywords: drug addiction; prevention; self-control; sign-tracking; storytelling; survey

Introduction

Drug abuse is one of the most destructive health problems in American society. From March 2016–March 2017, 65,094 people lost their lives because of a drug overdose, up from 54,786 the previous year (Ahmad, Rossen, Spencer, & Sutton, 2017). Because of the rising prevalence of opioid abuse, President Trump has recently deemed the epidemic a national health emergency. The consequences of abusing drugs not only have devastating effects on the individual but also have an enormous negative impact on society at large. In 2007, the societal costs of drug abuse overall have been estimated at \$200 billion in legal costs, healthcare costs, lost production in the workplace, and criminal justice fees (National Drug Intelligence Center, 2011). With drug overdose now the leading cause of death among the American population under the age of 50 (Kaplan, 2017), effective drug prevention programs are essential in reducing drug abuse. Unfortunately, the majority of programs used today have failed to decrease the prevalence of usage.

One of the most well-known drug addiction prevention programs is Drug Abuse Resistance Education (DARE). The DARE program has been widely employed in schools since 1983. DARE police officers undergo 80 hours of training to teach 17 lessons each lasting for about 45–60 minutes. The DARE program's mission is to reduce use of illicit drugs, improve psychosocial behaviors including social skills and self-esteem, and build community relationships through lectures and role-playing activities (Pan & Haiyan, 2009). Unfortunately, DARE has no reliable short-term or long-term impact on students' drug use nor does it have any significant positive effects on social and psychological risk factors (Ennett, Rosenbaum, Flewelling, Bieler, Ringwalt, & Bailey, 1994; Dukes, Ullman, & Stein, 1997; Hansen & McNeal, 1997).

DARE's lack of efficacy may be due to the brevity of the program itself, which takes only a few weeks to complete. The lessons of an effective drug program should be reinforced in multiple sessions ideally spanning the course of a few years (Engs & Stuart, 1988). This allows the program to progress with students as they reach various situations that correspond with increasing age. Also, with constant reinforcement over the years, lessons are remembered better. The role-playing scenarios point to another problem with DARE. In a classroom setting, a role-playing exercise does not arouse the same feelings of anxiousness and the desire to fit in, which are prominent characteristics of a peer pressure experience. Practicing how to act in a classroom might not adequately prepare a student for the real thing. Moreover, students use drugs for reasons other than peer pressure, such as self-medicating, rebellion, curiosity, genetic predisposition, and/or emulating a parental figure or role model (Engs & Stuart, 1988). Due to the backlash, DARE reconstructed their curriculum and combined forces with the prevention program Keepin' It Real. But, once again, this new adaptation was still shown to be ineffective at reducing drug use (Caputi & McLellan, 2017).

Another way of delivering the anti-drug message to young people is through fear appeal. Scare tactics often impact attitudes and future intentions but have no reliable effect on changing that individual's behavior (Witte & Allen, 2000; Hastings, Stead, & Webb, 2004). Instead of managing the fear of the danger to their health, people tend to manage their fear by claiming this could never happen to them (Witte & Allen, 2000; Hastings, Stead, & Webb, 2004) or the outcome is unlikely (Goldberg, Halpern-Felsher, & Millstein, 2002). Initially, people may have

an emotional reaction after seeing the scare tactic, but after repeated exposure, that emotional reaction diminishes or disappears (Goldberg, Halpern-Felsher, & Millstein, 2002).

A new drug prevention tool is needed. The scientific short stories, *The Tail of the Raccoon: Secrets of Addiction (Illustrated)* and *The Tail of the Raccoon, Part II: Touching the Invisible (Illustrated)*, lend themselves to a storytelling approach to deliver a message to young people about the loss of self-control that is induced by sign-tracking. From the beginning of time, storytelling of fables, allegories, and anecdotes has been passed from generation to generation as a way of teaching life's lessons to young people (Goodman-Scott, Carlisle, Clark, & Burgess, 2016). Storytelling is especially effective in teaching lessons to special needs populations (Olçay Gül, 2016) and has a broad range of effective applications, even increasing language skills in non-native English speakers (Kalantari & Mahmood, 2015). The success of storytelling with children and youth suggests that delivering scientific messages regarding self-control and sign-tracking via the storytelling vehicle may increase their awareness of the drug addiction process. In this regard, several studies have already shown that storytelling is an effective way to educate youth about drug addiction (Arthur & Nelson, 2003; Metzger & Janet, 1992).

Sign-tracking is an animal learning model of the clinical psychopathology of drug addiction. Drug-taking by humans typically provides experience with a pairing of an object (e.g., a cocktail glass) with a reward (e.g., the pleasurable effects of alcohol). Repeated acts of drug-taking lead to what scientists call "sign-tracking," the automatic, reflexive inclination to approach and contact and "consume" the object that predicts the reward (Tomie, Badawy, & Rutyna, 2016; Tomie & Sharma, 2014). Sign-tracking is triggered by the object and the performance of sign-tracking is poorly controlled by the subject, even when the action serves no purpose or is counterproductive or maladaptive. The tendency to develop sign-tracking is well established as a behavioral marker of an individual's subsequent vulnerability to addiction (Flagel, Watson, Robinson, & Akil, 2007; Hirschman, 1992; Tunstall & Kearns, 2015). Although sign-tracking may lead to maladaptive behavior, it is nevertheless widely exhibited in many animals, including humans (Joyner, Gearhardt, & Flagel, 2018; Reilly, Berndt, & Woods, 2016; Srey, Maddux, & Chaudhri, 2015; Tomie, Badawy, & Rutyna, 2016; Tomie & Sharma, 2014; Valyear, Villaruel, & Chaudhri, 2017; Versace, Kypriotakis, Basen-Engquist, & Schembre, 2016).

The objective of reading the scientific short stories is to equip the reader with an understanding of how object-reward pairings may induce the loss of self-control due to sign-tracking that leads to the development of addictive behaviors. In this way, the reader of the story will better understand that reflexive actions may occur even though they were not intended. The chapter by Tomie, Jeffers, and Zito (this volume) shows that the addiction blind spot, the widespread inability of the user to recognize the loss of self-control of drug-taking, contributes greatly to their demise, as they continue to assume that quitting drug use is simply a matter of deciding to do it. When they finally attempt to quit and discover that they can't, it is telling that many complain that they were blindsided and never saw their loss of self-control coming. The better informed reader is more likely to develop vigilance enabling them to identify these unintended acts of drug-taking much earlier in the drug addiction process. The goal is to enhance awareness of the loss of self-control earlier in the drug addiction process to allow the individual to prevent the downward spiral into drug addiction. Tomie, Jeffers, and Zito (this volume) provide a sign-tracking account of the addiction blind spot. The failure to recognize the loss of self-control is a

key feature of the drug addiction process because it allows the downward spiral into the pit of drug addiction. The results of the present paper offer a possible way to address the blind spot problem. We report that using scientific short stories about sign-tracking and drug addiction, as an educational tool in 9th–12th grade students, is effective in boosting their awareness of the loss of self-control and the relationship between loss of self-control and drug addiction.

The scientific phenomenon of sign-tracking was exhibited in the first story, *The Tail of the Raccoon: Secrets of Addiction (Illustrated)*, when a raccoon, later named Sign Tracker, was instructed to bring wood to Mapache, a blind Native American warrior, in exchange for a delicious food reward. After repeated pairings of the wood and the food, the raccoon began to behave strangely. He started behaving toward the wood as though it were the food. Eventually, he spent all his time obsessively handling wood, which he gnawed and chewed, and dragged into the lake to be cleaned. He brought very little of this damp and shredded wood to Mapache and received few food rewards. This cycle of obsessively chewing and cleaning wood continued to spiral out of control, until finally help intervened. Note that the raccoon's behavior was maladaptive and makes no sense, because gnawing the wood resulted in the loss of the real food reward. The raccoon's behavior revealed the loss of self-control, the lack of connection between his action and his intention. The action of the raccoon was to gnaw the wood, which interfered with his intention, which was to deliver the wood to Mapache, to get the delicious food rewards. To regain self-control, the raccoon had to leave that spot in the woods and relocate to the other side of the Great Lake, away from the dark forest of the kindling wood that triggered the raccoon to exhibit sign-tracking behavior.

In the second story, *The Tail of the Raccoon, Part II: Touching the Invisible (Illustrated)*, sign-tracking was exhibited by a young raccoon, Sign Tracker's son, named Lepus. In the nearby woods, a spider named Alatro offered Lepus a vial of her potion in exchange for goods stolen from the Native Americans. Lepus enjoyed drinking the potion from the vial, and Lepus agreed to steal the goods to exchange for a vial of potion. Right away, Lepus enjoyed the intoxicating effects of the spider's potion, and so he quickly developed a routine of stealing the goods to trade for the vial of potion. Before long, after many pairings of the vial and the potion's effects, Lepus lost control over his actions. The mere sight of the vial triggered an automatic, irresistible reflex to drink from the vial. In the presence of the vial, Lepus ingested the potion repeatedly, to the point of excess, and beyond what he had intended. Eventually, after repeated episodes of intoxication, his family had to step in to save him.

The story emphasizes an important aspect of the drug addiction process that is typically overlooked. Note that the actions of sign-tracking closely resemble the actions of voluntary drug-taking. Therefore, sign-tracking is likely to pass for voluntary drug-taking. For further discussion of this issue see the chapter by Tomie, Jeffers, and Zito (this volume), titled "Sign-Tracking Model of the Addiction Blind Spot." When Lepus saw the vial, he was triggered reflexively to reach out and drink from it, causing him to ingest the potion. But, while the action was neither intended nor voluntary, the triggered reflex was readily mistaken and misconstrued as a routine voluntary act of drug-taking. A casual observer, and even Lepus himself, would likely conclude that Lepus simply needs to make better decisions, when, in fact, Lepus actually was acting reflexively and had no control over his actions. The purpose of the story is to introduce the reader to the existence of reflexive sign-tracking. In this way, students will be better able to see

how Lepus lost control of his drug-taking, and how this occurred due to pairings of the vial and potion that induced sign-tracking of reflexively triggered drug-taking.

Loss of self-control is a central theme in both of The Tail of the Raccoon stories. Self-control is an important protective factor when it comes to addiction (National Institute on Drug Abuse, 2003). The goal is to raise students' awareness of self-control, to strengthen the students' will power and their ability to resist drug use. Our hypothesis is that these stories will be an effective means of delivering a drug prevention message by increasing the students' understanding of the process of losing self-control and how this can lead to drug addiction.

Methods

Participants. Our population consisted of a total of 51 students enrolled in grades 9–12 of East Mountain School (EMS) of Carrier Clinic. The Educational Program provides a structured setting, with both Community Day students and Residential students. EMS is an alternative school located on the grounds of Carrier Clinic and is considered a division of the facility. The school program emphasizes the individual's growth and improvement, focusing on the development of appropriate academic and social skills, as delineated per each student's Individualized Education Plan (IEP).

Each classroom ranges in age from 13 to 18, divided appropriately to foster learning. Students of EMS enter the program throughout the school year, upon placement from their home school district. The members of the school staff are adapted to facilitate the rolling admissions of the student population. Some of the students are referred to the residential program, East Mountain Youth Lodge. The Lodge and school work in cooperation to set goals in both academic and behavioral areas. Finally, other students, usually requiring some interventions and accommodations, also attend EMS as Community Day students, commuting to EMS from their home district.

EMS is divided into three unique subprograms. Each subprogram within the school specializes in their own particular approach to addressing students with interfering behaviors. All students remain in their specific sub-school and do not usually interact with students in any of the other sub-schools. The students in sub-school #1 are usually classified as having intense behavioral issues, including, for some students, conduct disorders or defiance disorders. The students in sub-school #2 have the greatest challenges. Most of these students learn to navigate school, while developing coping skills for various issues, such as panic attacks, clinical depression, self-injurious behaviors, and ideation. The students enrolled in sub-school #3 may present with behavioral and anxiety issues. Students from any of the sub-schools may come from a foster home environment, or from an abusive family environment, or from a low-income family environment. Students from any of the sub-schools may be familiar with drug addiction, based on their prior experience of sharing a home with an addicted family figure or from their prior firsthand experience with using addictive drugs.

Procedures

The Human Subjects Institutional Review Board of Rutgers University approved this study. Several weeks before the study began, parental consent letters explaining the study were mailed to the home address of each student's parents. The parents then signed and mailed back the parental consent letter giving permission for their child, under the age of 18, to participate in the study. Each student for whom parental consent was obtained was then given the minor assent form. The minor assent form explained the study and requested the approval of the minor to participate. All students who signed the minor assent form were eligible to participate in the study.

In the weeks prior to initiating the study, Professor Tomie and his research assistant, Emily Levitch conducted three individual one-hour orientation sessions attended by the EMS administrators and teachers. Each orientation session consisted of a PowerPoint slide show and video materials that explained the science of sign-tracking and how sign-tracking relates to the loss of self-control of drug-taking. In addition, the orientation introduced the audience to the scientific raccoon short stories (*The Tail of the Raccoon: Secrets of Addiction [Illustrated]* and *The Tail of the Raccoon, Part II: Touching the Invisible [Illustrated]*). These scientific short stories would be used in the classroom with the intention of boosting awareness of the loss of self-control and how the loss of self-control contributes to drug addiction. The orientation also introduced the audience to the many formats in which these stories could be used in the classroom, including having individual students each read the illustrated books themselves; having an instructor read-aloud to the class, while also providing each student with an individual binder copy of abbreviated versions of the illustrated books; providing each student with an iPad digital e-book text-only speech-enabled version of the book, to be used in conjunction with the binder copies of abbreviated versions of the illustrated books; and, for group participation and for purposes of review, projecting the iPad digital e-book onto a screen in the classroom, to be used in conjunction with the binder copies of abbreviated versions of the illustrated books. Also introduced to the audience were the control stories (*Where the Buffaloes Begin* and *The Call of the Wild*). The control stories were similar in content, length, reading level, and illustration quality, to the scientific short stories, but the content of the control stories did not pertain to self-control.

Prior to the start of the study, students from each sub-school were divided into two groups. One group was assigned the scientific short story, *The Tail of the Raccoon: Secrets of Addiction (Illustrated)* (hereafter referred to as "Tail I"), while the other group was assigned a different short story, *Where the Buffaloes Begin* (hereafter referred to as "Buffaloes"). For each sub-school, there were three students randomly assigned to the Tail I group for each one student randomly assigned to the Buffaloes group. Prior to reading the stories, all students were asked to fill out Survey 1-Pre (see Table 8.1) to assess their pretreatment baseline awareness of self-control. For purposes of analysis, the seven questions were organized into two clusters. Questions 2, 4, and 6 (Target Questions) specifically pertain to self-control, while Questions 1, 3, 5, and 7 (Non-Target Questions) do not pertain to self-control. Each student was asked to rate their agreement with each Survey question by selecting the best alternative provided by a 5-point scale, where 1 = "Poor," 2 = "Below Average," 3 = "Average," 4 = "Above Average," and 5 = "Excellent." The mean pretreatment baseline ratings of the "Tail I" group and the "Buffaloes"

group were assessed by Survey 1-Pre prior to reading their assigned stories in order to determine the presence of preexisting group mean differences.

Table 8.1: The Tail of the Raccoon: Secrets of Addiction Survey 1

To help us meet our goal to help students and educators please complete this survey.

Statements:	Poor	Below Average	Average	Above Average	Excellent
1. The illustrations inside this book are . . .					
2. My understanding of what causes an individual to lose self-control is . . .					
3. Relative to three years ago, the improvement in my reading skills is . . .					
4. My understanding of how the loss of self-control leads to drug addiction is . . .					
5. The illustrations that accompany this story are . . .					
6. My understanding of what it means to lose self-control is . . .					
7. The quality of this story is . . .					
Comments:					

After completion of Survey 1-Pre, all students were provided with access to their assigned story using one or more of the methods described earlier. For all students in sub-school #1 during the first week, the teacher read the story aloud to the class, who were each provided with a binder copy of an abbreviated version of the illustrated books. After the first week, slower readers and students who were absent during parts of the first week were allowed to catch up using an iPad digital e-book text-only speech-enabled version of the book and also available were the binders of illustrations described earlier. For all students in sub-school #3, the teachers read the stories aloud to the class, who were each provided with a binder copy of an abbreviated version of the illustrated books. All students in sub-school #2 were given the choice of engaging the story in the way that they found most suitable, and they were free to change methods at any time. Upon completion of the reading of their assigned story, each student in the Tail I group and in the Buffaloes group was asked to fill out Survey 1-Post, which was identical to Survey 1-Pre. The purpose of Survey 1-Post was to assess the students in each group their posttreatment awareness of self-control after they had completed the reading of their assigned story. Our hypothesis was that the Tail I group, which had read a story introducing them to the loss of self-control due to sign-tracking would score higher on the Target Questions (2, 4, and 6) related to self-control, relative to the Buffaloes group, which had read a story unrelated to the loss of self-control. In addition, our hypothesis was that the groups would not differ on the Non-Target Questions (1, 3,

5, and 7) that did not pertain to self-control. Forty-six students completed Survey 1-Pre, and 51 students completed Survey 1-Post.

Data Analysis

For each subject, a self-report of their awareness of self-control was assessed using paper-and-pencil surveys that were administered immediately before and after the subject read each story. Each survey response was entered into an Excel spreadsheet with the identity of the subject encrypted by code. For each group and for each subject and for each survey, the mean, standard deviation, and standard error of the mean were derived. For each subject, the mean of the survey scores for questions 2, 4, and 6 were derived for each survey. For each subject, the mean of the survey scores for questions 1, 3, 5, and 7 were derived for each survey.

Between-Groups Effects: The effect of groups (The Tail of the Raccoon: Secrets of Addiction (Illustrated) [Tail I] versus Where the Buffaloes Begin [Buffaloes]) on mean responses to each of the seven survey questions (Questions 1, 2, 3, 4, 5, 6, or 7) was assessed by separate one-way univariate analysis of variance (ANOVA) using Systat Inferential Statistical Analysis Software (San Jose, California), with an alpha level of 0.05, two-tailed.

Repeated-Measures Effects: The effect of groups on mean responses to each cluster of questions pertaining to self-control was evaluated by comparing each individual subject's mean responses to all Target Questions (Questions 2, 4, and 6) and all Non-Target Questions (Questions 1 and 3), as assessed by mixed-design 2×2 two-way ANOVA, with two levels of groups (Tail I versus Buffaloes) and two levels of cluster (Target Questions versus Non-Target Questions). Effects of groups on mean survey (Pre-Story versus Post-Story) scores was assessed by repeated-measures, mixed-design 2×2 ANOVA with two levels of group (Tail I versus Buffaloes) and two levels of survey (Pre-Story versus Post-Story).

Results, Experiment 1

Survey 1-Pre, Between-Groups Effects: Survey 1 was given prior to reading the first story and was administered to assess any preexisting baseline differences between the groups. For Survey 1, students were told not to answer questions 5 and 7 because these questions asked for their opinions of the story, which they had not read at that point. For each of the five remaining questions for Survey 1, one-way ANOVA revealed no significant mean differences between the groups, (all F 's < 1).

Survey 1-Pre, Repeated-Measures Cluster Effects: On Survey 1-Pre for the "Tail I" group, the mean ratings for the Target Cluster questions (2, 4, and 6), $n = 37$, and the Non-Target Cluster Questions (1 and 3), $n = 37$, were 3.42 ± 0.15 and 3.39 ± 0.15 , respectively, and this difference was not significant, ($F < 1$). Similarly, on Survey 1-Pre for the "Buffaloes" group, $n = 9$, the mean ratings for the Target Cluster questions (2, 4, and 6) and the Non-Target Cluster Questions (1 and 3), were 3.35 ± 0.41 and 3.54 ± 0.36 , respectively, and this difference was not significant, ($F < 1$). To confirm the results of the one-way analysis, a 2×2 mixed-design, repeated-measures ANOVA was conducted. This analysis revealed no significant main effect of groups ($F < 1$), no

significant main effects of cluster ($F < 1$), and no significant interaction effect between groups and cluster, ($F < 1$). See Figure 8.1.

Survey 1-Post, Between-Groups Effects: For each of the seven individual questions for Survey 1-Post, one-way ANOVA revealed no significant mean differences between the groups, (all p 's > 0.10). One-way ANOVAs also revealed no significant mean differences between the groups on mean ratings for Target Cluster questions (2, 4, and 6), $F < 1$, or on mean ratings for Non-Target Cluster Questions (1, 3, 5, and 7), $F < 1$. See Figure 8.2.

Survey 1-Post Repeated-Measures Cluster Effects: On Survey 1-Post for the "Tail I" group, the mean ratings for the Target Cluster questions (2, 4, and 6), $n = 37$, and the Non-Target Cluster Questions (1, 3, 5 and 7), $n = 37$, did not differ significantly, $F < 1$. Similarly, on Survey 1-Post for the "Buffaloes" group, $n = 9$, the mean ratings for the Target Cluster questions (2, 4, and 6), $n = 9$, and the Non-Target Cluster Questions (1 and 3), $n = 9$, did not differ significantly, $F < 1$.

Repeated-Measures Surveys and Cluster: For Survey 1-Pre and Survey 1-Post, mixed-design $2 \times 2 \times 2$, three-way ANOVA revealed no significant main effect of groups, ($F < 1$) and no significant main effect of cluster, ($F < 1$), and no significant main effect of survey, ($F < 1$). There was no significant two-way interaction between groups and cluster, ($F < 1$). There was a significant two-way interaction between groups and surveys, $F(1, 35) = 4.70$, $p = 0.04$, indicating that irrespective of groups, ratings on Survey 1-Pre were significantly higher than on Survey 1-Post. There was no significant three-way interaction between groups, cluster, and survey, ($F < 1$). See Figure 8.3.

Discussion, Experiment 1

The results of Experiment 1 provided no reliable evidence that reading "Tail I" enhanced awareness of loss of self-control. There were no significant effects of groups on Survey 1-Post on mean ratings of Target Cluster Questions pertaining to self-control (Questions 2, 4, and 6) or for Non-Target Cluster Questions that did not pertain to self-control (Questions 1, 3, 5, and 7). Comparing across surveys (Survey 1-Pre versus Survey 1-Post) for each individual question provided no evidence of improvement in awareness of self-control in either group. Reading "Tail I" did not produce an increase in the ratings for Target Cluster questions and this was also the case for Non-Target Cluster Questions, and, in addition, this was also the case for both Target Cluster and Non-Target Cluster questions for the "Buffaloes" group. This may be due, at least in part, to the overall trend toward lower ratings across surveys. For the "Buffaloes" group, mean responses to Survey 1-Post for Non-Target Questions (1 and 3) were 0.50 lower than for Survey 1-Pre, indicating an overall deterioration in ratings of questions that did not pertain to self-control. This overall trend toward lower ratings would decrease the likelihood of observing improvement in ratings of questions pertaining to self-control.

Methods, Experiment 2

Participants: The subjects were the same students that had participated in Experiment 1. For Experiment 2, all subjects were assigned to the same groups to which they had been previously assigned for Experiment 1.

Procedures: Upon completion of Survey 1-Post, all student were asked to fill out Survey 2-Pre (see Table 8.2), which was identical to Survey 1-Post, except that the Target Questions (2, 4, and 6) pertained to self-control as it related to drug addiction, and students were asked to answer questions 5 and 7 on Survey 2-Pre and Survey 2-Post. Upon completion of Survey 2-Pre, all students began reading their second assigned story. One group was assigned the scientific short story, *The Tail of the Raccoon, Part II: Touching the Invisible (Illustrated)* (hereafter referred to as “Tail II”), while the other group was assigned a different short story, *The Call of the Wild* (hereafter referred to as “Call”). All students were provided with access to their second assigned story using one or more of the methods described earlier. For Experiment 2, all students in sub-school #1 were provided with an iPad digital e-book text-only speech-enabled version of the book, and, also available were the binders of illustrations described earlier. For all students in sub-school #3, the teachers read the stories aloud to the class, who were each provided with a binder copy of an abbreviated version of the illustrated books. All students in sub-school #2 were given the choice of engaging the story in the way that they found most suitable, and they were free to change methods at any time.

Table 8.2: *The Tail of the Raccoon, Part II: Touching the Invisible Survey 2*

To help us meet our goal to help students and educators, please complete this survey.

Statements:	Poor	Below Average	Average	Above Average	Excellent
1. My level of interest in reading stories is . . .					
2. My understanding of what causes an individual to lose their self-control of their drug-taking is . . .					
3. Relative to three years ago, the improvement of my reading skills is . . .					
4. My understanding of why the loss of self-control is difficult to recognize is . . .					
5. The illustrations that accompany this story are . . .					
6. My understanding of what I can do to prevent the loss of self-control is . . .					
7. Based on the cover illustration of this book, I predict that the story inside is . . .					
Comments:					

Upon completion of the reading of their second assigned stories, each student in the Tail II Group and in the Call Group was asked to fill out Survey 2-Post, which was identical to Survey 2-Pre, to assess their awareness of self-control after they had completed the reading of their

second assigned story. With respect to Survey 2, 48 students completed Survey 2-Pre, and 47 students completed Survey 2-Post.

Data Analysis, Experiment 2: Same as Experiment 1

Results, Experiment 2

Survey 2-Pre, Between-Groups Effects: Survey 2-Pre was administered prior to reading the second story. For each of the seven questions for Survey 2-Pre, one-way ANOVA revealed no significant main effect of group, (all F 's < 1). The mean rating for Target Cluster Questions (2, 4, and 6) for each student and the mean rating for Non-Target Cluster Questions (1, 3, 5, and 7) for each student were derived. The group means for Target Cluster Questions did not differ significantly, ($F < 1$), and the group means for Non-Target Questions did not differ significantly, ($F < 1$). See Figure 8.4.

Survey 2-Pre, Repeated-Measures Cluster Effects: On Survey 2-Pre for both groups, there were no significant differences in mean ratings for the Target Cluster Questions (2, 4, and 6) compared to the Non-Target Cluster Questions (1, 3, 5 and 7), (both F 's < 1). To confirm the results of the one-way analysis, a 2×2 , mixed-design, repeated-measures ANOVA was conducted. Both groups, "Tail II" and "Call," for Survey 2-Pre for the repeated measures analysis 2×2 ANOVA revealed a similar pattern of results, as there was no significant main effect of groups, ($F < 1$), no significant main effect of cluster, $F(1, 46) = 3.16, p > 0.05$, and no significant interaction effect between groups and cluster, ($F < 1$).

Survey 2-Post, Between-Groups Effects on Self-Control Questions: Target Cluster Questions: The mean rating for Question 2 for the "Tail II" group, $n = 32$, and the "Call" group, $n = 15$, was 3.28 ± 0.23 and 2.93 ± 0.26 , respectively, and this difference was not significant, ($F < 1$). The mean rating for Question 4 for the "Tail II" group, $n = 31$, and the "Call" group, $n = 13$, was 3.42 ± 0.22 and 2.54 ± 0.28 , respectively, and this difference was significant, $F(1, 42) = 4.76, p = 0.04$. The effect size is 0.72. The mean rating for Question 6 for the "Tail II" group, $n = 31$, and the "Call" group, $n = 15$, was 3.71 ± 0.18 and 2.73 ± 0.35 , respectively, and this difference was significant, $F(1, 44) = 7.15, p = 0.01$. The effect size is 0.84. See Figure 8.5.

Non-Target Cluster Questions: The mean rating for Question 1 for the "Tail II" group, $n = 28$, and the "Call" group, $n = 13$, was 2.82 ± 0.21 and 3.00 ± 0.35 , respectively, and this difference was not significant, ($F < 1$). The mean rating for Question 3 for the "Tail II" group, $n = 31$, and the "Call" group, $n = 13$, was 3.32 ± 0.24 and 3.54 ± 0.26 , respectively, and this difference was not significant, ($F < 1$). The mean rating for Question 5 for the "Tail II" group, $n = 31$, and the "Call" group, $n = 15$, was 3.26 ± 0.22 and 2.80 ± 0.27 , respectively, and this difference was not significant, $F(1, 44) = 1.45, p = 0.24$. The mean rating for Question 7 for the "Tail II" group, $n = 32$, and the "Call" group, $n = 15$, was 2.97 ± 0.15 and 2.47 ± 0.31 , respectively, and this difference was not significant, $F(1, 45) = 2.59, p = 0.11$. See Figure 8.6.

Survey 2-Post Effects of Groups on Cluster: The mean rating for Target Cluster Questions (2, 4, and 6) for each student was derived, and the mean rating for Non-Target Cluster Questions (1, 3, 5, and 7) for each student was derived. The group means for Target Cluster Questions for the

“Tail II” group, $n = 32$, and the “Call” group, $n = 15$, were 3.46 ± 0.19 and 2.79 ± 0.25 , respectively, and this difference was significant, $F(1, 45) = 4.31$, $p = 0.04$. The effect size is 1.05. The group means for the Non-Target Cluster Questions for the “Tail II” group, $n = 32$, and the “Call” group, $n = 15$, were 3.09 ± 0.16 and 2.93 ± 0.21 , respectively, and this difference was not significant, ($F < 1$). To further evaluate, a 2×2 , mixed-design, repeated-measures ANOVA was conducted. This analysis revealed no significant main effect of groups, $F(1, 45) = 2.56$, $p = 0.12$, and no significant main effect of cluster ($F < 1$), but there was a marginally significant interaction effect between groups and cluster, $F(1, 45) = 2.85$, $p < 0.10$. Fisher’s LSD revealed that on Survey 2-Post for the Target Cluster Questions, the ratings of the “Tail II” group were significantly higher than the ratings of the “Call” group, $p < 0.05$. See Figure 8.7.

Repeated-Measures Surveys and Cluster Effects: For Survey 2-Pre, there were no significant effects of groups on ratings of Target Cluster Questions, ($F < 1$). For Survey 2-Post, the “Tail II” group, $n = 24$, provided significantly higher ratings for the Target Cluster Questions than the “Call” group, $n = 10$, $F(1, 32) = 7.54$, $p = 0.01$. The effect size was 1.04. There was no significant two-way interaction between groups and cluster, $F(1, 32) = 1.48$, $p > 0.20$. There was no significant two-way interaction between groups and surveys, ($F < 1$). There was a significant three-way interaction between groups, cluster, and survey, $F(1, 32) = 6.51$, $p = 0.02$. Fisher’s LSD revealed that on Survey 2-Post for Target Cluster Questions (2, 4, and 6) the “Tail II” group provided higher mean ratings relative to the mean ratings of the “Call” group, $p < 0.05$. See Figure 8.8. This effect was not observed for Non-Target Cluster Questions, ($F < 1$), which revealed no main effect of groups, no main effect of survey, and no interactions between groups and survey, (F ’s < 1). See Figure 8.9.

Repeated-Measures Surveys 2-Pre and 2-Post: For each of the seven questions, mean ratings for “Tail II” group, for Survey 2-Pre and Survey 2-Post were compared by separate one-way ANOVAs. In all cases, the effects of survey were not statistically significant, (all p ’s > 0.05). For each of the seven questions, mean ratings for “Call” group, for Survey 2-Pre and Survey 2-Post were compared by separate one-way ANOVAs. In all cases, the effects of Survey were not statistically significant, (all p ’s > 0.05).

Discussion, Experiment 2

All subjects participating in Experiment 2 had previously participated in Experiment 1 and remained in their assigned group for both experiments. The results of Experiment 2 provided consistent evidence that reading “Tail II” after reading “Tail I” enhanced awareness of loss of self-control and, in addition, enhanced awareness of how the loss of self-control contributed to drug addiction. This conclusion is supported by several lines of convergent evidence. Note that the experimental design included several controls to allow for more precise specification of the factors responsible for our effects. For example, the control group read “Buffaloes” and “Call” that were comparable to “Tail I” and “Tail II” in reading level, number of pages, quality of illustrations, and general story time, but “Buffaloes” and “Call” differed from “Tail I” and “Tail II” in that “Buffaloes” and “Call” were not stories about losing self-control. Therefore, the group differences in ratings to questions specifically related to self-control were unlikely due to nonspecific extra-experimental factors such as distractions related to reading, or the schedule of completing assignments, or to interactions among students or instructors.

The mean rating for Cluster Target Question #4 was significantly higher for the “Tail II” group, relative to the “Call” group, indicating that reading “Tail II” significantly elevated ratings of their understanding of why the loss of self-control is difficult to recognize. The effect size was 0.72, indicating that the significance level is not an artifact of group size. In addition, for the “Tail II” group, relative to the “Call” group, the mean rating for Cluster Target Question #6 was significantly higher, indicating significantly elevated ratings of their understanding of what they can do to prevent the loss of self-control. The statistical significance is confirmed by calculation of the effect size which was 0.84 for Question 6, indicating that the difference in group means was large in relation to the within group variances. On Survey 2-Post for the “Tail II” group, relative to the “Call” group, the mean rating for Cluster Target Questions (2, 4, and 6) that pertain to the loss of self-control was significantly higher, indicating significantly elevated rating of the general understanding of the loss of self-control. This significance is confirmed with an effect size of 1.05. Finally, it should be noted that although the self-control Question 2 produced group mean rating differences that failed to achieve statistical significance, the mean was higher for the “Tail II” group than for the “Call” group, indicating that for all of the self-control questions, the pattern of group mean differences were similar.

The experimental design also included control questions in the form of Cluster Non-Target Questions that did not pertain to self-control. This allowed more precise specification of the beneficial effects of reading the stories. The beneficial effect of reading “Tail II” relative to reading “Call” was specific to self-control awareness, as significant group differences were not observed in mean Non-Target Cluster Questions (1, 3, 5, and 7) scores, indicating that the reading of “Tail I” then “Tail II” enhanced awareness of the loss of self-control more than reading “Buffaloes” and then “Call,” and this beneficial effect was specific to self-control awareness and was not due to extraneous factors that boosted rating of all questions including those that did not pertain to self-control.

The experimental design included repeated testing by administering the survey before and after reading the stories. The Survey 2-Pre data obtained before reading the second stories revealed that the groups did not differ on any of the questions, indicating that the pre-story baselines for the two groups were comparable. This shows that the groups did not differ in their awareness of self-control before reading the stories, but the groups did differ significantly in their awareness of self-control after reading the stories. Therefore, the post-story differences cannot be due to preexisting baseline differences between the groups.

Survey 2-Post scores were generally lower than Survey 2-Pre scores, for the “Call” group. Mean responses to Survey 2-Post for Non-Target Questions (1, 3, 5, and 7) were 0.15 lower than for Survey 2-Pre, indicating that there was an overall deterioration in ratings of questions across surveys that did not pertain to self-control. This deterioration effect across surveys was also observed for Cluster Target Questions as well as Cluster Non-Target Questions. The notable exception was Question 6, which for the “Tail II” group increased mean ratings from Survey 2-Pre to Survey 2-Post, and this effect was significant, $p < 0.05$. This reveals that “Tail II” improved the understanding of what the students can do to prevent the loss of self-control, and this improvement between Survey 2-Pre and Survey 2-Post was observed despite the overall deterioration in ratings across surveys.

This deterioration effect was quite prevalent and was noted previously in Experiment 1, where Survey 1-Post scores were overall, across all questions, 0.50 points lower than Survey 1-Pre scores. The reason for the decrease in scores across surveys may be due to the students' reaction to being asked to repeatedly answer the same or similar questions. Another factor could be due to the mere passing of days and weeks since the beginning of the school session, combined with the monotony of the daily regimen of reading the stories day after day. This suggests that a general within-semester fatigue effect may have developed amongst the students.

It should also be noted that this study was conducted under a number of challenging circumstances. The students were attending EMS, which is an alternative, out-of-district school, located on the grounds Carrier Clinic. Many of the students are challenged with interfering behaviors or troublesome childhood histories. Students may be diagnosed with social adjustment problems or are in need of clinical services. There is usually a component of poor academic performance as well. For many of the students, their reading skill levels were several grades below their mean age-appropriate reading skill levels, and, consequently, it may be that many of the students did not particularly enjoy reading stories or filling out surveys. These factors may have contributed to the overall decline in ratings across surveys, as the students became fatigued by daily readings, as the semester wore on. Whatever the cause, the decline in scores was observed across all questions, irrespective of their relevance to self-control, and this created a headwind for the hypothesis of post-story improvement in awareness of self-control. Nevertheless, despite the headwind, significantly improved ratings were obtained for Question 6 for the "Tail II" group.

The finding that "Tail II" significantly improved knowledge of self-control through a storytelling format is consistent with previous findings on the success of storytelling to deliver a message (Goodman-Scott, Carlisle, Clark, & Burgess, 2016). Storytelling is especially useful in populations with intellectual disabilities (Olçay Gül, 2016), who are particularly vulnerable to substance use disorders (Arthur & Nelson, 2003; Metzger & Janet, 1992). The results of the present studies indicate that storytelling about sign-tracking is effective in boosting awareness of the loss of self-control, and this, in turn, suggests that both "Tail I" and "Tail II" may be effectively employed as part of a drug prevention education program in schools.

The loss of self-control of drug-taking is stealthy, sneaking up on the unsuspecting, largely because reflexively triggered involuntary acts of sign-tracking of drug-taking closely resemble voluntary and intended acts of drug-taking (see chapter in this volume "Sign-Tracking Model of the Addiction Blind Spot" by Tomie, Jeffers, & Zito). For this reason, for all drug users, the early instances of the loss of self-control of drug-taking are readily ignored or misconstrued as a poor decision, allowing additional repetitions of drug-taking to strengthen further the reflexive actions that presage full-blown drug addiction. The remedy is to increase awareness of this problem, to enhance vigilance of what might otherwise be overlooked. The present studies reveal that storytelling about sign-tracking can significantly increase awareness of the loss of self-control and improve understanding of how the loss of self-control contributes to the development of drug addiction. The present findings suggest that reading these stories about the science of sign-tracking and the loss of self-control may provide an early education tool for the primary prevention of drug addiction.

With regard to future research, the results of the present study revealed a significant effect of reading the “Tail I”-“Tail II” sequence on awareness of the loss of self-control. It remains unclear, however, the degree to which this effect was dependent upon reading “Tail I” since surveys showed no between-groups differences in the ratings of the self-control questions after reading “Tail I.” Future research will address the possibility that reading only “Tail II” may be sufficient to provide the improvement in awareness of self-control, or, alternatively, if the additional dosing of the focus on self-control provided by “Tail I” is necessary for “Tail II” to produce its significant effects.

With regard to design flaws of the present study, it should be acknowledged that in the present study, the teachers were not blind to the experimental conditions. All teachers attended all training seminars given prior to the initiation of the experiments. They were then assigned to their groups. It is possible that their knowing the experimental conditions may have influenced their behavior during the course of the study. Along the same lines, it should also be acknowledged that in the present study, students within a sub-school intermingled during the study. Some students in each sub-school were in the “Tail I and II” group, while others were in the control group, and students in one of the groups may have talked about the stories to students in the other group. Another factor that should be acknowledged is the student population. This study was conducted in an out-of-district school. Many of the subjects had conduct disorders or behavioral issues that could have affected their ability to absorb the story and learn more about self-control. There were many students who missed school days and had to catch up, and student turnover during the semester was considerable, as students dropped out of the program. This created missing data issues that impacted the number of students in our populations of repeated-measures assessments. Future research projects are planned at more traditional school settings where presumably less daily volatility in the classroom could be more conducive to reading stories and providing more consistent within-subjects survey data.

Further longitudinal follow-up studies are required to assess if a student’s increased awareness of the loss of self-control predicts that student’s subsequent resistance to drug use. We need to ascertain if the messages of these books regarding the loss of self-control are helpful to the students later in life when confronted with the opportunity to engage in drug use. A longitudinal study consisting of students who read “Tail I” and “Tail II” compared to students who read control stories, who were then assessed for their subsequent drug habits years later would provide the crucial test of the effectiveness of the stories in actually preventing drug use. Currently in development are additional scientific short stories on sign-tracking. These illustrated stories are intended to extend the range of application for this drug prevention tool from the 3rd grade through the 9th grade.

Acknowledgments

Authors thank the teaching staff of East Mountain School, including Tom Discafani, Barbara Wojtowicz, Lawrence Booth, Bonnie Kole, Chris Saponara, Charles Sumners, Erika Witkowski, and Eric Olsen. Authors also thank the East Mountain School administrators Dr. Stephen Bender, PhD., DD; Dr. Angela DiDolce, ND; and Mr. Russel Hudson for their guidance and assistance during this project. In addition, authors thank Ayon Iwasaki and Collin A. Brown for their assistance with statistical analyses. This research was supported by the Center of Alcohol Studies

at Rutgers University, New Brunswick, New Jersey, and the Carrier Clinic, Belle Meade, New Jersey.

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Figures

Survey 1

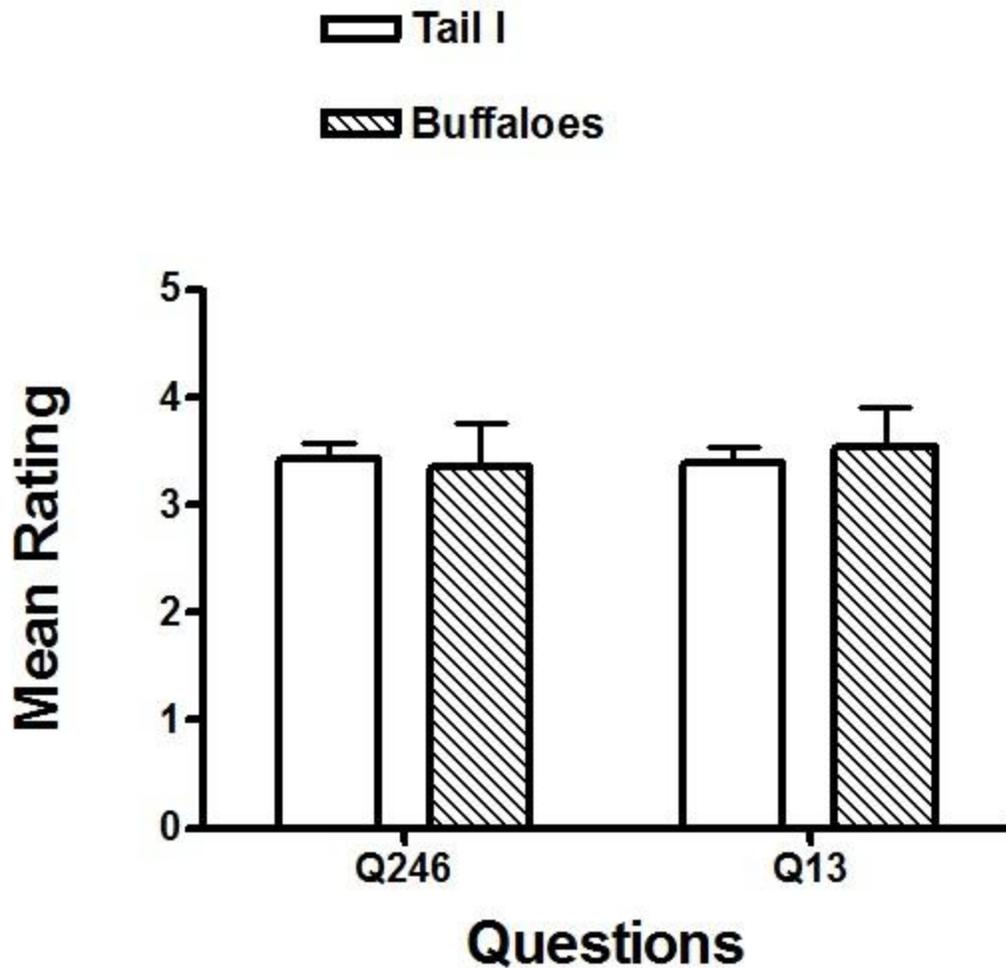


Figure 8.1. Mean Survey 1 (Pre-Story) ratings to the Target Cluster of Questions 2, 4, and 6 and to the Non-Target Cluster of Questions 1 and 3 for subjects in the Tail I Group and the Buffaloes Group. The vertical bars represent the standard error of the mean (S.E.M.). The Target Cluster of Questions 2, 4, and 6 pertain to self-control. The Non-Target Cluster of Questions 1 and 3 do not pertain to self-control. Subjects in the Tail I Group were assigned The Tail of the Raccoon: Secrets of Addiction. Subjects in the Buffaloes Group were assigned Where the Buffaloes Begin.

Survey 2

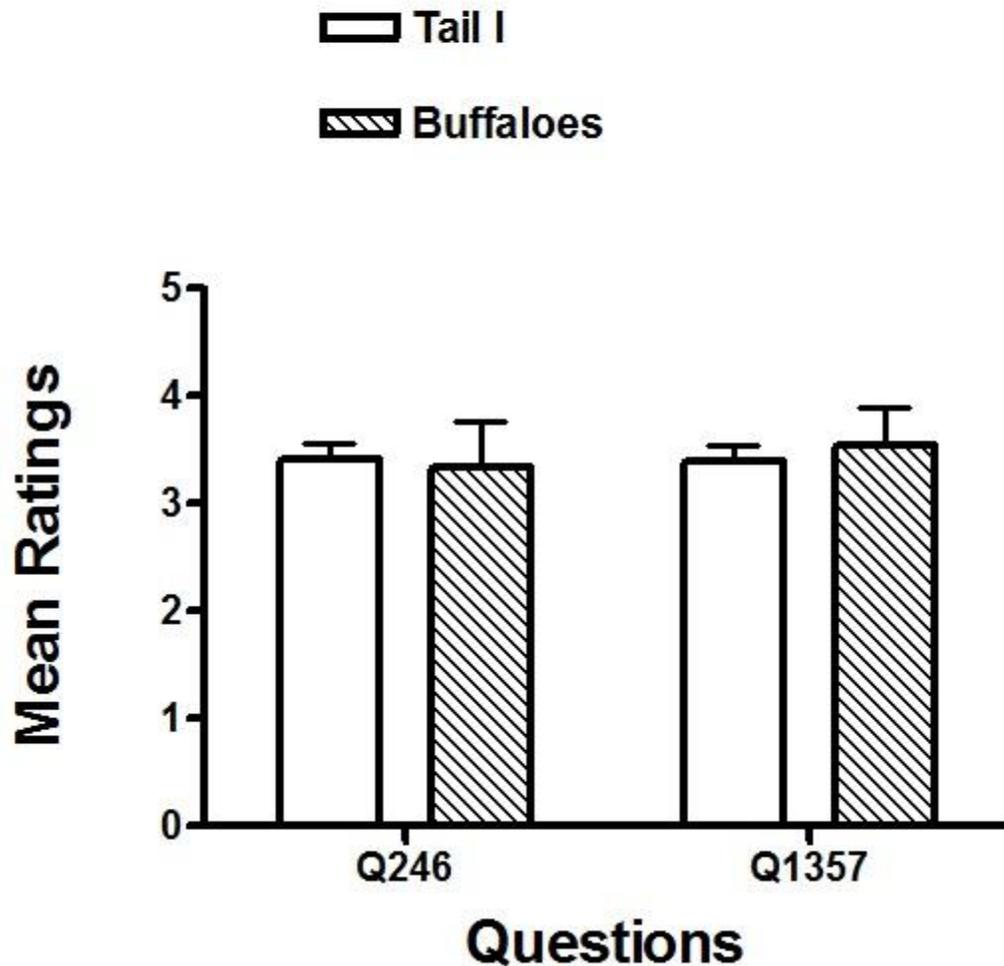


Figure 8.2. Mean Survey 2 (Pre-Story) ratings to the Target Cluster of Questions 2, 4, and 6 and to the Non-Target Cluster of Questions 1, 3, 5, and 7 for subjects in the Tail I Group and the Buffaloes Group. The vertical bars represent the standard error of the mean (S.E.M.). The Target Cluster of Questions 2, 4, and 6 pertain to self-control. The Non-Target Cluster of Questions 1, 3, 5, and 7 do not pertain to self-control. Subjects in the Tail I Group were assigned *The Tail of the Raccoon: Secrets of Addiction*. Subjects in the Buffaloes Group were assigned *Where the Buffaloes Begin*.

Questions 1357

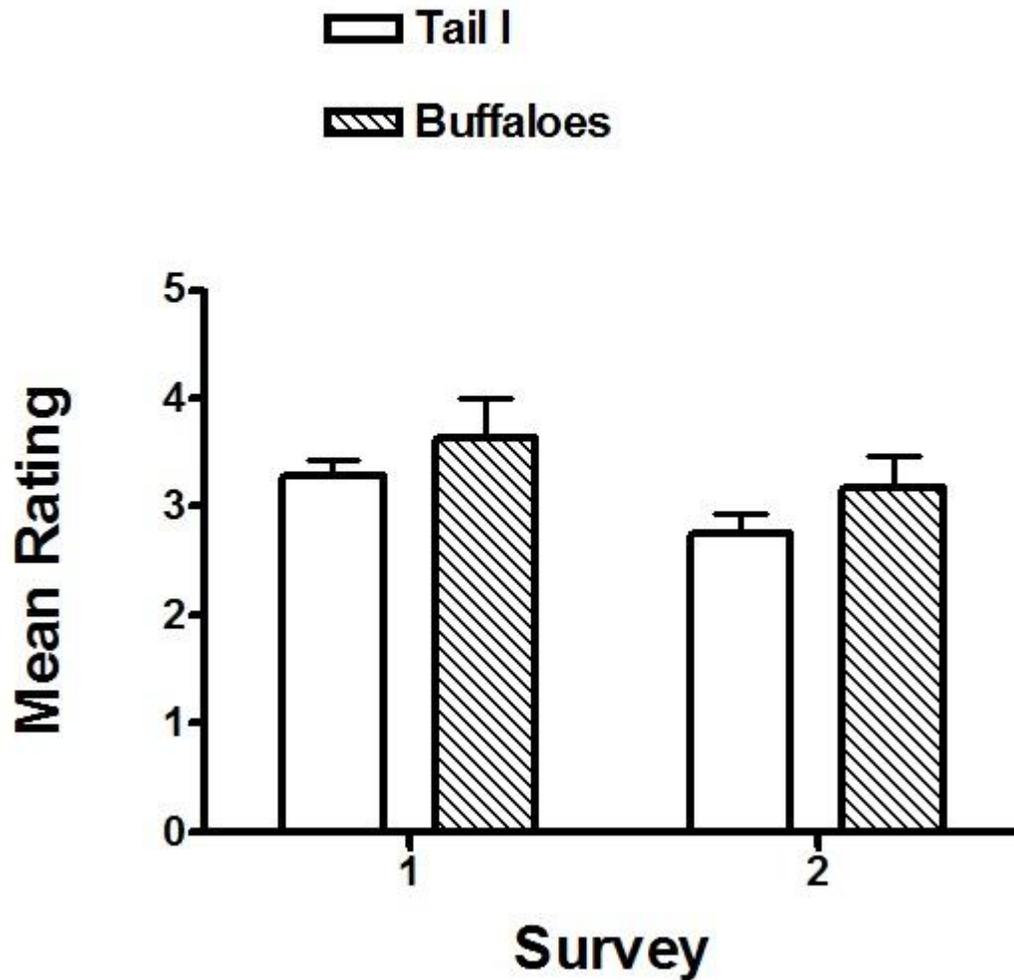


Figure 8.3. Mean Survey 1 (Pre-Story) and Survey 2 (Post-Story) ratings to Non-Target Cluster Questions 1, 3, 5, and 7 for subjects in the Tail I Group and the Buffaloes Group. The vertical bars represent the standard error of the mean (S.E.M.). Subjects in the Tail I Group were assigned *The Tail of the Raccoon: Secrets of Addiction*. Subjects in the Buffaloes Group were assigned *Where the Buffaloes Begin*.

Survey 3

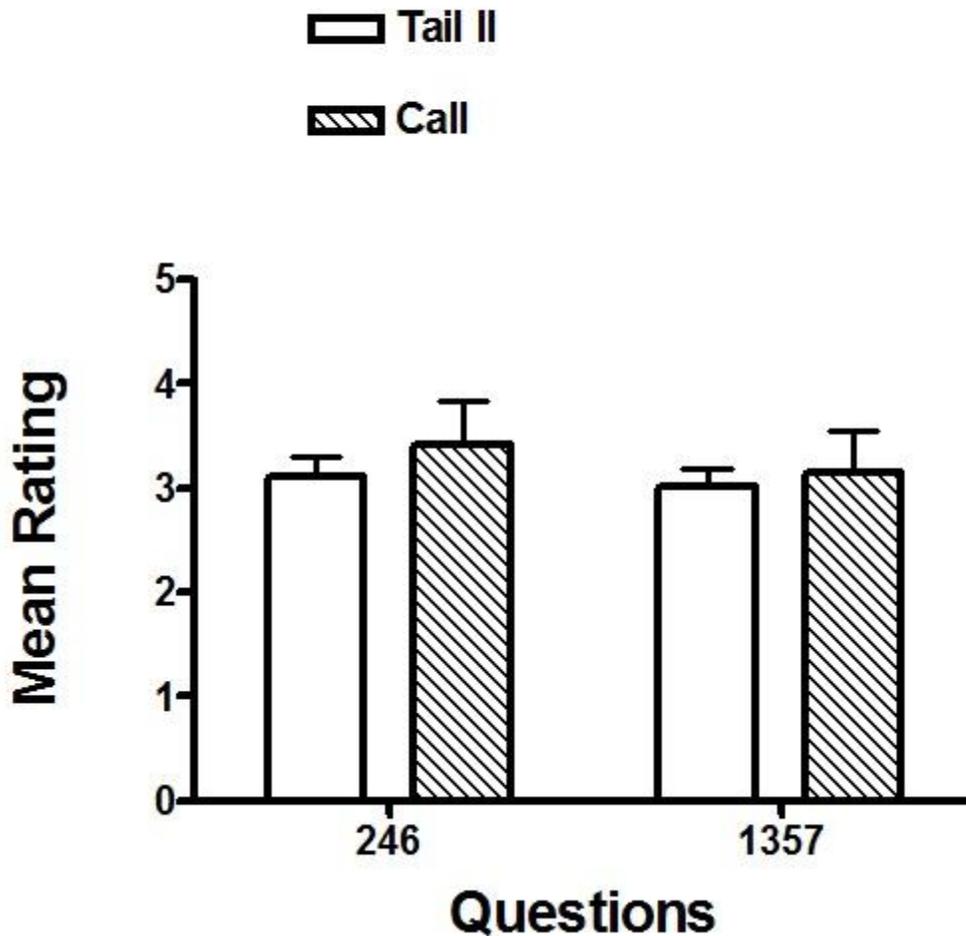


Figure 8.4. Mean Survey 3 (Pre-Story) ratings to the Target Cluster of Questions 2, 4, and 6 and to the Non-Target Cluster of Questions 1, 3, 5, and 7 for subjects in the Tail II Group and the Call Group. The vertical bars represent the standard error of the mean (S.E.M.). The Target Cluster of Questions 2, 4, and 6 pertain to self-control. The Non-Target Cluster of Questions 1, 3, 5, and 7 do not pertain to self-control. Subjects in the Tail II Group were assigned The Tail of the Raccoon, Part II: Touching the Invisible. Subjects in the Call Group were assigned The Call of the Wild.

Survey 4

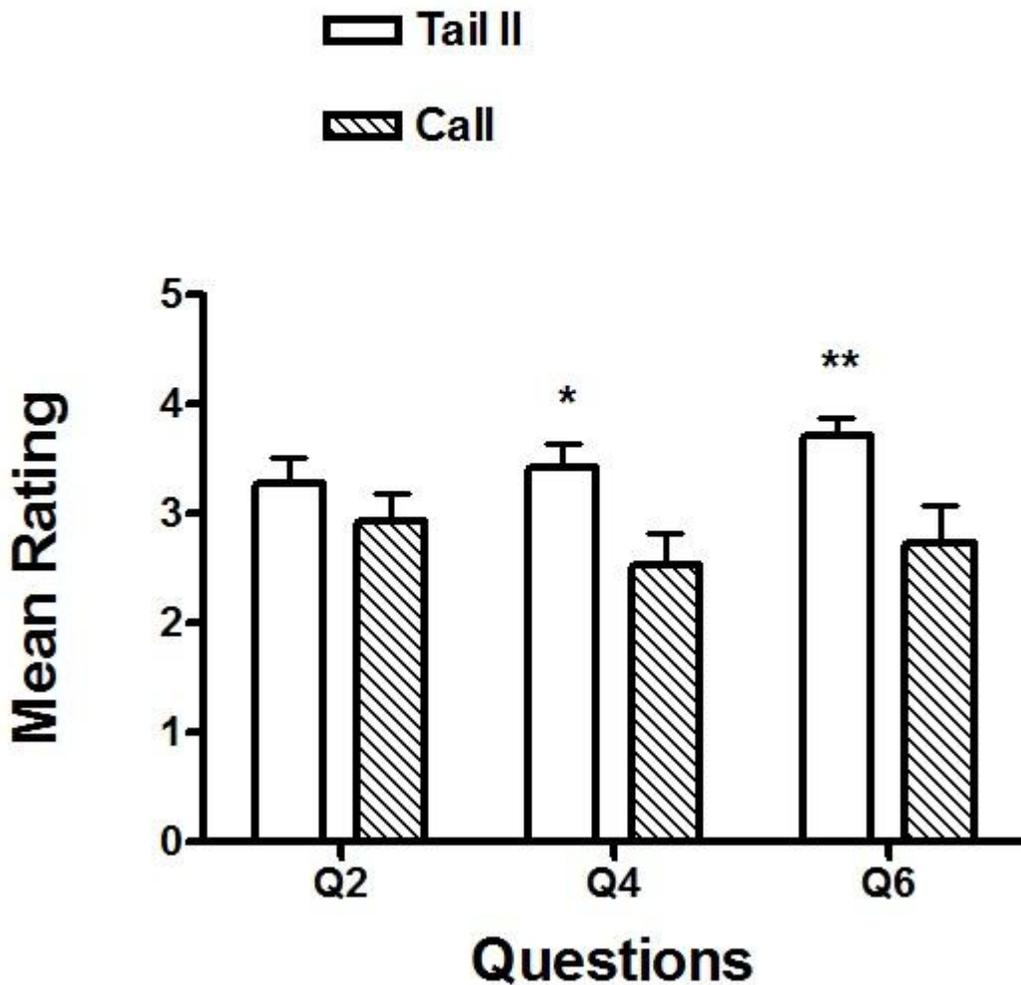


Figure 8.5. Mean Survey 4 (Post-Story) ratings to Questions 2, 4, and 6 for subjects in the Tail II Group and the Call Group. The vertical bars represent the standard error of the mean (S.E.M.). Subjects in the Tail II Group were assigned *The Tail of the Raccoon, Part II: Touching the Invisible*. Subjects in the Call Group were assigned *The Call of the Wild*. The single asterisk (*) indicates that the adjacent columns differ significantly, $p < 0.05$. The double asterisk (**) indicates that the adjacent columns differ significantly, $p < 0.01$.

Survey 4

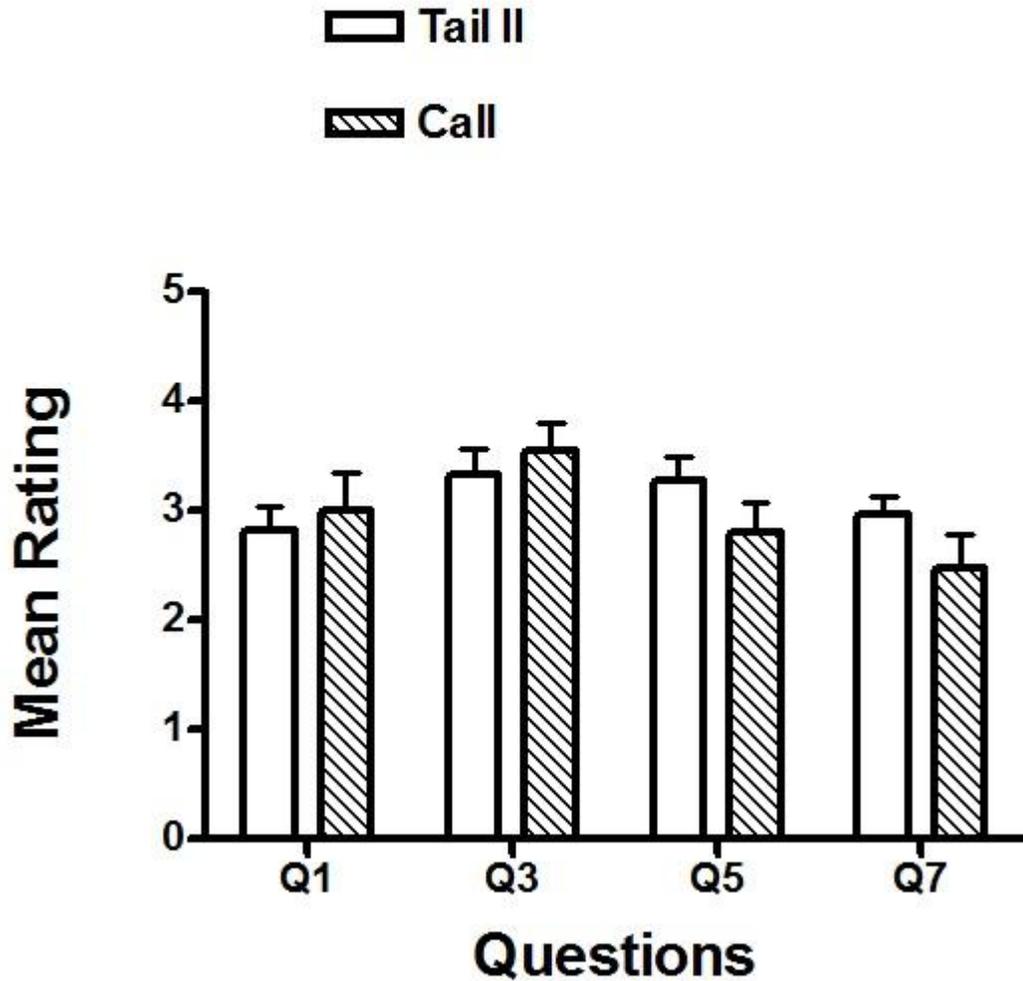


Figure 8.6. Mean Survey 4 (Post-Story) ratings to Questions 1, 3, 5, and 7 for subjects in the Tail II Group and the Call Group. The vertical bars represent the standard error of the mean (S.E.M.). Subjects in the Tail II Group were assigned The Tail of the Raccoon, Part II: Touching the Invisible. Subjects in the Call Group were assigned The Call of the Wild.

Survey 4

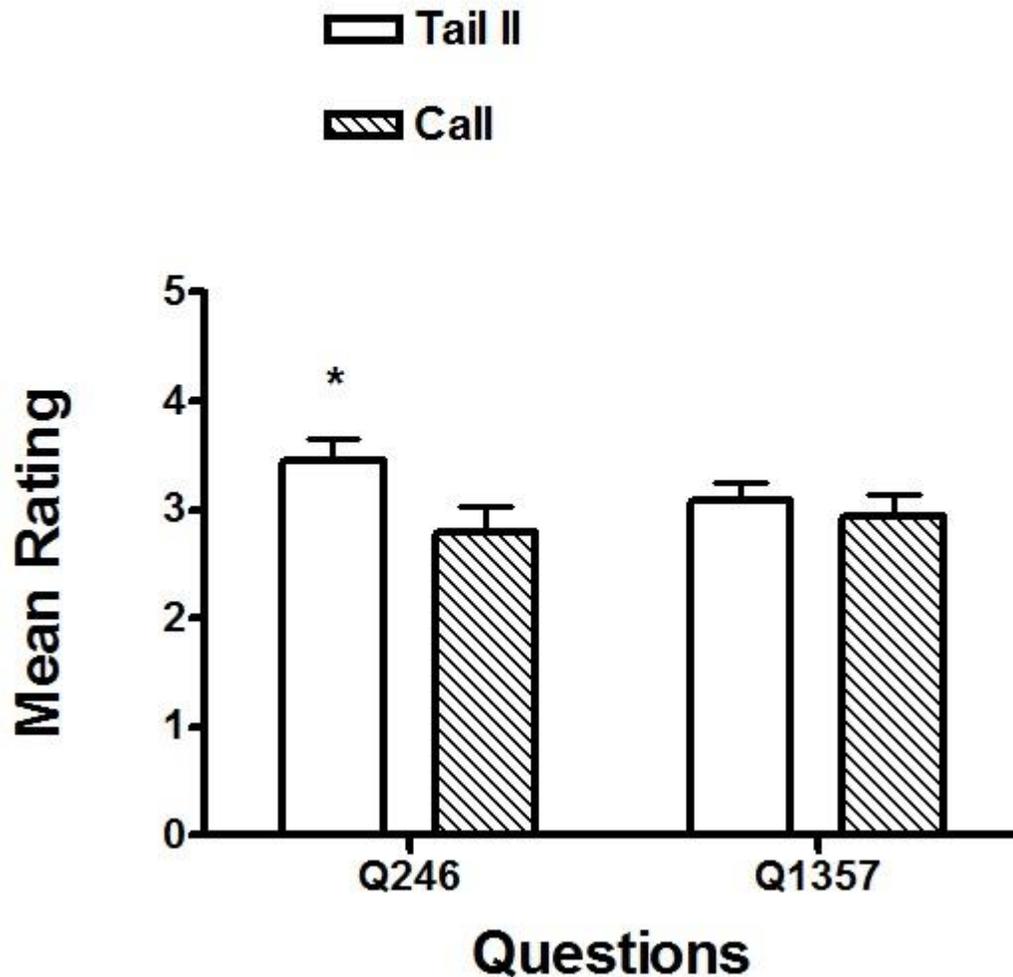


Figure 8.7. Mean Survey 4 (Post-Story) ratings to the Target Cluster of Questions 2, 4, and 6 and to the Non-Target Cluster of Questions 1, 3, 5, and 7 for subjects in the Tail II Group and the Call Group. The vertical bars represent the standard error of the mean (S.E.M.). The Target Cluster of Questions 2, 4, and 6 pertain to self-control. The Non-Target Cluster of Questions 1, 3, 5, and 7 do not pertain to self-control. Subjects in the Tail II Group were assigned The Tail of the Raccoon, Part II: Touching the Invisible. Subjects in the Call Group were assigned The Call of the Wild. The single asterisk (*) indicates that the adjacent columns differ significantly, $p < 0.05$.

Questions 246

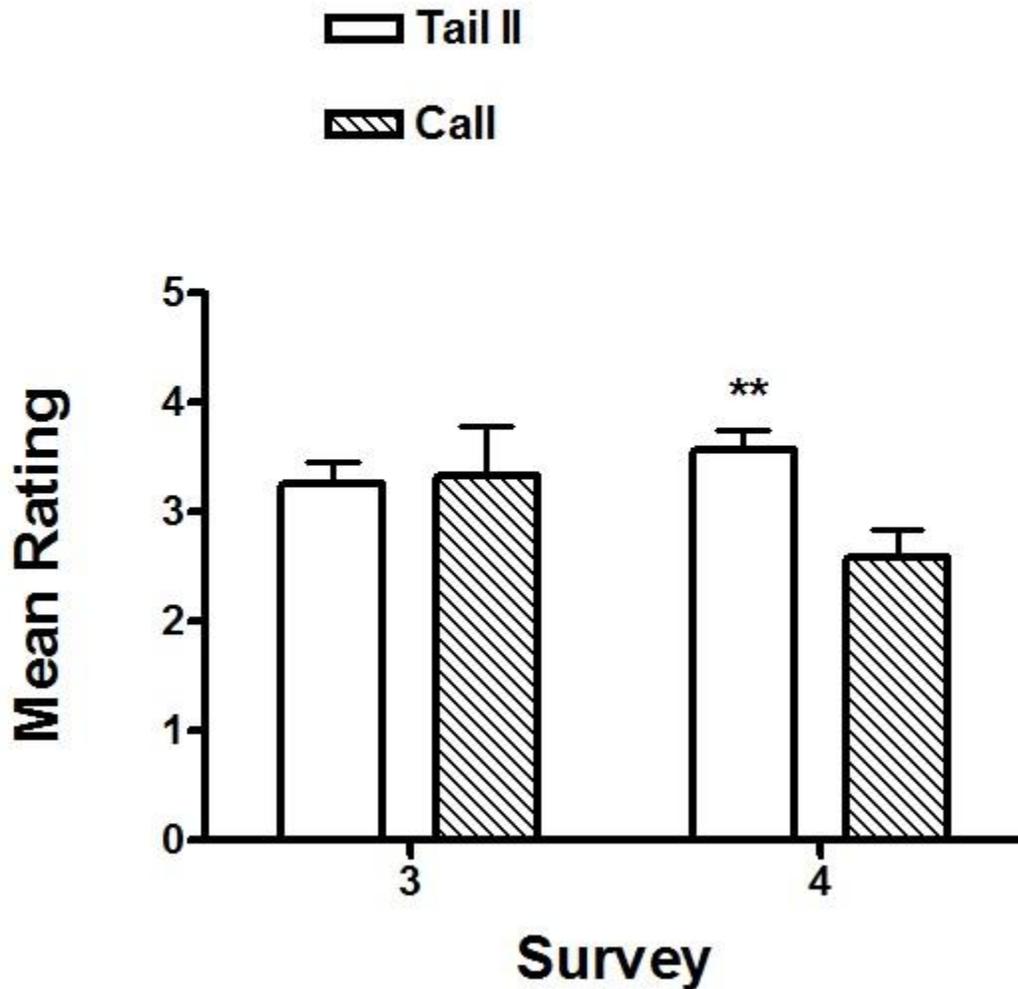


Figure 8.8. Mean Survey 3 (Pre-Story) and Survey 4 (Post-Story) ratings to the Target Cluster of Questions 2, 4, and 6 for subjects in the Tail II Group and the Call Group. The vertical bars represent the standard error of the mean (S.E.M.). Subjects in the Tail II Group were assigned The Tail of the Raccoon, Part II: Touching the Invisible. Subjects in the Call Group were assigned The Call of the Wild. The double asterisks (**) indicates that the adjacent columns differ significantly, $p < 0.01$.

Questions 1357

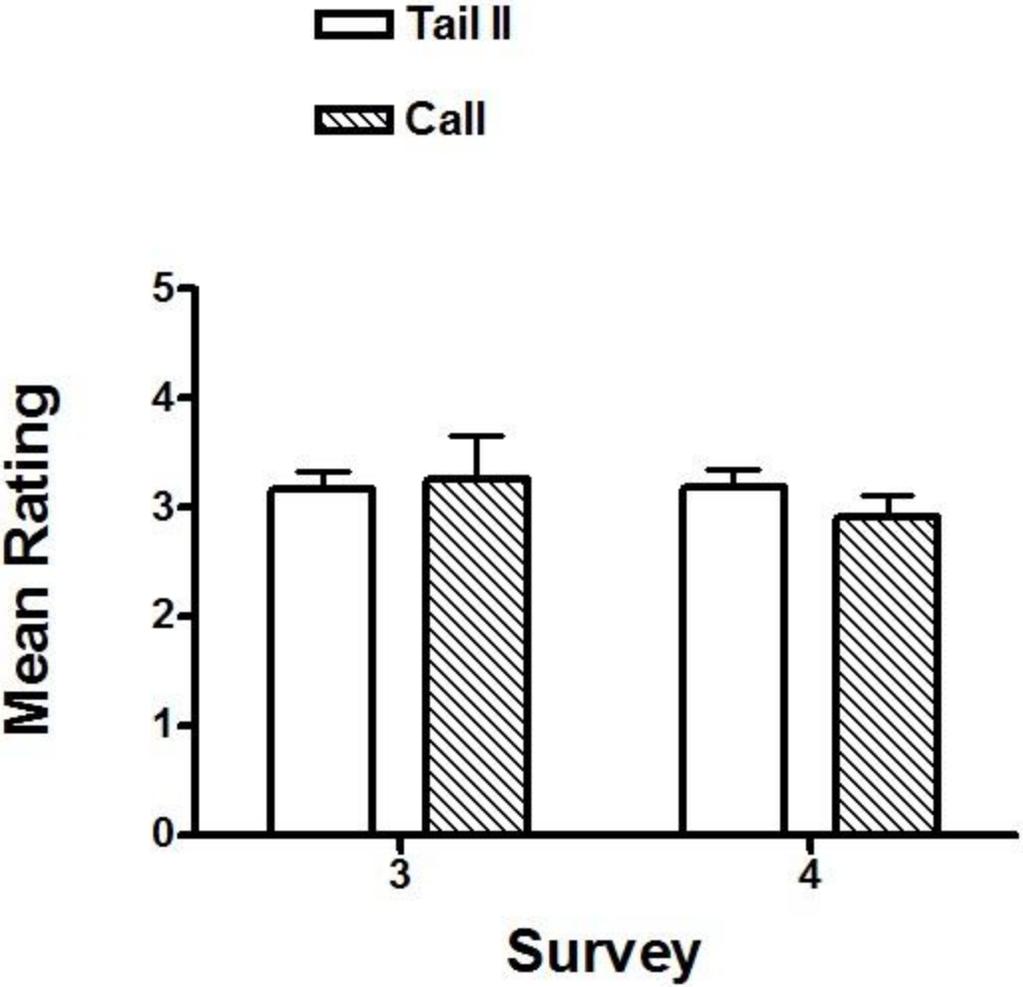


Figure 8.9. Mean Survey 3 (Pre-Story) and Survey 4 (Post-Story) ratings to the Non-Target Cluster of Questions 1, 3, 5, and 7 for subjects in the Tail II Group and the Call Group. The vertical bars represent the standard error of the mean (S.E.M.). Subjects in the Tail II Group were assigned The Tail of the Raccoon, Part II: Touching the Invisible. Subjects in the Call Group were assigned The Call of the Wild.